R E M A R K S

Reconsideration of this application, as amended, is respectfully requested.

THE CLAIMS

Claims 1-17 have been amended to more clearly recite the features of the present invention in better U.S. form, as well as to make some minor grammatical improvements and to correct some minor antecedent basis problems so as to put them in better form for issuance in a U.S. patent. The informality pointed out by the Examiner has been corrected.

No new matter has been added, and it is respectfully requested that the amendments to claims 1-17 be approved and entered.

It is respectfully submitted, moreover, that the amendments to the claims are not related to patentability, and do not narrow the scope of the claims either literally or under the doctrine of equivalents.

THE PRIOR ART REJECTION

Claims 1-6, 9, 10 and 12 were rejected under 35 USC 102 as being anticipated by JP 09-209402; claims 7 and 11 were rejected under 35 USC 103 as being obvious in view of the combination of JP 09-209402 and USP 3,920,081 ("Terai et al"); and claims 8

and 13-17 were rejected under 35 USC 103 as being obvious in view of the combination of JP 09-209402 and USP 6,637,111 ("Sasaki et al"). These rejections, however, are respectfully traversed.

According to the present invention as recited in independent claim 1, each of the legs of the crawler frame is bifurcated into front and rear leg sections and each of the leg sections is formed from cast steel. With this structure, complicated welding lines can be avoided, and the number of parts and welded places of the crawler frame can be reduced, thereby reducing the number of processes required to form the crawler frame.

On page 2 of the Office Action, the Examiner asserts that Figs. 4 and 6 of JP 09-209402 show legs that are bifurcated into front and rear leg sections that are formed of cast steel. However, the Examiner has not provided an English language translation of JP 09-209402, and therefore has merely relied upon Figs. 4 and 6 to support the assertions on pages 2 and 3 of the Office Action.

Submitted herewith is an English language translation of JP 09-209402 to show that JP 09-209402 clearly does not disclose, teach or suggest the features of the present invention as recited in independent claim 1 whereby each of the legs of a crawler frame is bifurcated into front and rear leg sections and each of the leg sections is formed from cast steel.

As explained in paragraph [0018] of the English language translation thereof, Fig. 4 of JP 09-209402 shows a track frame 1 made from an upper plate 1U and a lower plate 1D which are bent to have a trapezoidal shape in a front view and are welded respectively to the upper and inner faces of the crawler frames 2. As shown in Figs. 4 and 17 of JP 09-209402, the upper plate 1U is divided into two parts, namely a left part 1UL and a right part 1UR, which are cut out of a steel sheet SP as shown in Fig. 17. According to JP 09-209402, moreover, the lower plate 1D is a one-piece plate that is cut out from a steel sheet. See paragraphs [0023], [0027] and [0028], for example, of the English language translation of JP 09-209402.

As explained in paragraph [0022], Fig. 6 of JP 09-209402 shows upper and lower plates 1'U and 1'D which are bent to have a trapezoidal shape in a front view and bridge between the crawler frames 2. And as explained in paragraph [0024], for example, the upper plate 1'U is a one-piece plate that is cut out from a steel sheet SP.

Accordingly, it is respectfully submitted that JP 09-209402 is clearly directed to legs of a track frame that are formed from a plurality of pieces that are cut out from steel sheets.

It is respectfully submitted, therefore, that JP 09-209402 clearly does not disclose, teach or suggest the features of the present invention as recited in independent claim 1 whereby each of the legs of a crawler frame is bifurcated into front and rear leg sections and each of the leg sections is formed from cast steel.

It is respectfully submitted, moreover, that Terai et al has merely been cited for the disclosure of a hole for a hydraulic oil pipe, and that Sasaki et al has merely been cited for the disclosure of a J groove weld.

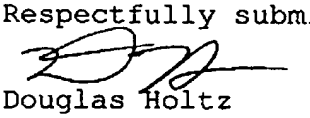
In view of the foregoing, it is respectfully submitted that the present invention as recited in independent claim 1, and claims 2-17 depending therefrom, clearly patentably distinguishes over JP 09-209402, Terai et al and Sasaki et al, taken singly or in any combination, under 35 USC 102 as well as under 35 USC 103.

* *

Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,



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(54) Title: Track Frame for Slewing-type Work Vehicle

JAPANESE PUBLISHED UNEXAMINED APPLICATION NO. 9-209402

[TITLE OF THE INVENTION] Track Frame for Slewing-type Work Vehicle

[ABSTRACT]

[Object] A track frame intended to avoid problems caused by displacement of the center of gravity when the structure of a compact slewing-type work vehicle having good turning ability is applied to a large-sized slewing-type work vehicle without modification and to avoid use of larger machine tools for machining parts.

[Means for Solving the Problems] As a member attached to a track frame 1, a swivel joint mounting member 3 is formed by cutting a square bar material SS and a bearing attaching seat 4 is welded to the track frame 1 after machining. The upper plate 1U of the track frame 1 is divided into two parts, i.e., a left upper plate 1UL and a right upper plate 1UR. A bent part P1 of a rear ribbed plate 1R between the upper plate 1U and a lower plate 1D is positioned closer to a widthwise center whereby the distance L between the leading end P2a of the rear ribbed plate 1R and the leading end P3a of a front (sic.) middle ribbed plate 1MR in weld parts of the upper part of a crawler frame 2 is increased.

[Claims]

1. A track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle,

wherein a swivel joint mounting member attached to the track frame is formed from a square bar material.

2. A track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle,

wherein a single-piece bearing mounting seat which has been machined is welded to the track frame.

3. A track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle and has an upper plate and a lower plate which are fit together,

wherein said upper plate is made of sheet material and divided into right and left parts at a center.

4. A track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle and has a structure in which an upper plate and a lower plate are coupled by a plurality of vertically extending ribbed plates and a rear ribbed plate among said ribbed plates is bent into the form of Japanese letter 八 in plan at right and left portions thereof,

wherein the bent parts of said rear ribbed plate are located near a widthwise center, and

wherein a long distance exists between a weld part of a side edge of said rear ribbed plate frame and a weld part of a side edge of a rear middle ribbed plate, said ribbed plates being welded to crawler frames.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an improved track frame structure which enables frame processing by conventional machine tools so that large-sized machine tools for frame processing become unnecessary when producing the large-size version of a compact slewing-type work vehicle.

[0002]

[Prior Art]

As there have been increasing demands for solutions to manpower

shortage and for laborsaving in recent years, small-sized slewing-type work vehicles with good turning ability have been available. This good turning ability is obtained by a structure in which a main body part including a bonnet that serves as an engine room does not bulge out especially at its rear end so that the main body part will not project outwardly from both crawlers even if the main body part turns.

[0003]

[Problems that the Invention is to Solve]

Where a larger slewing-type work vehicle is produced, employing the above-described main body structure which provides good turning ability, the shape of the main body part which does not bulge out at its rear end causes an increase in the weight of the implement arm composed of a front boom, an arm and a bucket, although it entails no problem in the conventional small, lightweight slewing-type work vehicles. In addition, since the rear end of the main body part does not bulge out and therefore the rear part of the slewing-type work vehicle is not heavy in weight, the center of gravity is shifted forward, causing imbalance. Further, as the weight of the implement arm increases, the strength of the track frame has to be increased. The invention is directed to solving such a problem.

[0004]

There is a general problem that production of a larger machine involves production of larger parts as well as use of larger machine tools for machining these parts. It is a large burden for factories which have been producing parts for compact slewing-type work vehicles to receive an order of part processing for large-sized slewing-type work vehicles, because they need to purchase new large-scale machine tools. Therefore, if an improved frame structure is invented, which enables machining of parts for large-sized slewing-type work vehicles with machine tools used for the parts of compact slewing-type work vehicles, the need to purchase large-scale machine tools can be obviated, leading to cost savings.

[0005]

[Means of Solving the Problems]

To solve the foregoing problem, the invention employs the following means. According to a first aspect, there is provided a track frame attached to a lower part of a pivotable main body frame of a slewing-type work vehicle, wherein a swivel joint mounting member attached to the track frame is made of a

square bar material.

[0006]

According to a second aspect, there is provided a track frame attached to a lower part of a pivotable main body frame of a slewing-type work vehicle, wherein a single-piece bearing mounting seat which has been machined is welded to the track frame.

[0007]

According to a third aspect, there is provided a track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle and has an upper plate and a lower plate which are fit together, wherein the upper plate is made of sheet material and divided into right and left parts at a center.

[0008]

According to a fourth aspect, there is provided a track frame for a slewing-type work vehicle, which is attached to a lower part of a pivotable main body frame of a slewing-type work vehicle and has a structure in which an upper plate and a lower plate are coupled by a plurality of vertically extending ribbed plates and a rear ribbed plate among the ribbed plates is bent into the form of Japanese letter 八 in plan at right and left portions thereof, wherein the bent parts of the rear ribbed plate are located near a widthwise center, and wherein a long distance exists between a weld part of a side edge of the rear ribbed plate frame and a weld part of a side edge of a rear middle ribbed plate, these ribbed plates being welded to crawler frames.

[0009]

[Best Mode for Carrying out the Invention]

Referring to the drawings, embodiments of the invention will be described.

Fig. 1 is an entire side view of a slewing-type work vehicle having a swivel joint mounting part 3 according to the invention. Fig. 2 is a plan view of a slewing-type work vehicle. Fig. 3 is an exploded perspective view showing a mounting structure of a main body frame attached to a frame of a conventional crawler running system. Fig. 4 is a plan view of a frame of a crawler running system for use in a large-sized slewing-type work vehicle. Fig. 5 is a side view of the same. Fig. 6 is a plan view of a frame of a crawler running system for use in a conventional compact slewing-type work vehicle. Fig. 7 is a side view of the same. Fig. 8 is a plan view showing a mounting structure of the swivel joint

mounting member 3 at a lower plate 1D of a track frame 1 according to the invention. Fig. 9 is a cross sectional view of the same. Fig. 10 is a perspective view showing a way of constructing the swivel joint mounting member 3 by cutting a square bar material SS. Fig. 11 is a plan view showing a mounting structure of a conventional swivel joint mounting member 3' at a lower plate 1'D of a conventional track frame 1'. Fig. 12 is a cross sectional view of the same. Fig. 13 is a perspective view of the conventional swivel joint mounting member 3'. Fig. 14 is a schematic plan view showing cutting-out of an upper plate 1'U from a steel plate SP, the upper plate 1'U being for a track frame 1' for the conventional compact slewing-type work vehicle. Fig. 15 is a schematic plan view showing cutting-out of an upper plate 1"U for a large-sized slewing-type work vehicle from a steel plate SP in a direction of a short side a in a conventional manner. Fig. 16 is a schematic plan view showing cutting-out of the same in a direction of a long side b. Fig. 17 is a schematic plan view showing cutting-out of an upper plate 1U for a track frame 1 for the large-sized slewing-type work vehicle of the invention from the steel plate SP, the upper plate 1U being laterally divided into two parts. Fig. 18 shows views of a crawler frame 2 for the large-sized slewing-type work vehicle, wherein (a) is a plan view and (b) is a side view. Fig. 19 shows views of a crawler frame 2' for the conventional compact slewing-type work vehicle, wherein (a) is a plan view and (b) is a side view. Fig. 20 is a plan view showing a suspension structure of an upper roller UR of the crawler frame 2. Fig. 21 is a side view of the same. Fig. 22 is a rear view of the same. Fig. 23 is a plan view showing a suspension structure of an upper roller UR of a conventional crawler frame 2'. Fig. 24 is a side view of the same. Fig. 25 is a side view of the same.

[0010]

Reference is made to Figs. 1 to 3 to explain the whole structure of a slewing-type work vehicle. It should be noted that although the crawler running system A shown in Fig. 3 is of a conventional type, the outline of its structure is the same as that of the crawler running system A of the invention shown in Fig. 1 which has a track frame 1 and a crawler frame 2, and therefore, the track frame 1, crawler frame 2 and swivel joint mounting member 3 will be described in place of the track frame 1', crawler frame 2' and swivel joint mounting member 3' shown in Fig. 3. In the slewing-type work vehicle shown in Figs. 1 and 2, a main body part C is in a condition where it turns through 180° on the crawler running system A, and a front loader FL is disposed so as to extend in a

length-wise direction of the crawler running system A. Herein, the side where idlers IR are suspended is called "front side" whereas the side where driving sprockets DS are suspended is called "rear side". FLC represents a hydraulic cylinder for driving the front loader.

[0011]

The slewing-type work vehicle shown in Figs. 1 and 2 is a slewing-type excavator. Its turning radius is substantially one half of the width of the work vehicle and its slewing frame is substantially circular. As depicted in the drawing, the work vehicle is equipped with a cabin 15 for the operator. In the frame structure of the crawler running system A, the track frame 1 is laid between the right and left crawler frames 2 and a plurality of track rollers TR are provided in the lower part of each crawler frame 2. An idler supporting member 8 is provided at the front end whereas a driving sprocket supporting member 9 is fixedly disposed at the rear end. An idler IR and a driving sprocket DS are supported by the idler supporting member 8 and the driving sprocket supporting member 9, respectively. Standing at a position upper than the substantial length-wise center is an upper roller supporting frame 10 for supporting an upper roller UR suspended therefrom. A crawler 11 is wound around the driving sprocket DS, the track roller TR, the idler IR and the upper roller UR.

[0012]

As shown in Figs. 1 and 3, the main body part C is rotatably mounted on the crawler running system A through a bearing B. In the main body part C, a main body frame 12 is coupled to the track frame 1 of the crawler running system A through the bearing B, and at its backmost part, a balancer 13 is secured. At its upper part, a bonnet 14 which serves an engine room etc. and a cabin 15 are mounted. At its foremost part, a proximal end of an implement arm composed of a boom 16, an arm 17 and a bucket 18 is pivotally supported. In the main body part C, hydraulic pumps, hydraulic valves, etc. are disposed. A hydraulic motor is attached to each of the driving sprockets DS suspended from the right and left crawler frames 2 of the crawler running system A. For supplying these hydraulic motors with pressure oil for controlling, a swivel joint SJ is disposed at the center so as to extend from the main body frame 12 to the bearing B and the track frame 1. The bottom of the swivel joint SJ is secured to the swivel joint mounting member 3 attached to the track frame 1.

[0013]

The slewing-type work vehicle is characterized in that the main body

frame 12 has a substantially circular shape in plan as shown in Fig. 2 and its rear end (i.e., a weld part of the balancer 13) does not bulge out backwardly so that even if the main body part C turns, the rear end will not project outwardly from the outer periphery of the crawler running system A. That is, this slewing-type work vehicle has good turning ability. This structure is one which has been already applied to a compact slewing-type work vehicle and is also applicable to the large-sized slewing-type work vehicle shown in Figs. 1 and 2 without modification.

[0014] This structure, however, has presented such a problem that while improved turning ability can be achieved, the rear part of the main body part is too short to make a balance with the implement arm located at the front part so that the center of gravity is shifted forward. This is not problematic to compact type work vehicles but a serious matter for large-sized work vehicles. For avoiding the displacement of the center of gravity while keeping good turning ability, it is desirable to increase the weight of a part lower than the main body part C, that is, the weight of the crawler running system A. Further, this is required to be implemented with economical means.

[0015]

In the invention, the swivel joint mounting member 3 secured to the track frame 1 is formed as described earlier. Specifically, a square bar material SS made of steel is cut as shown in Fig. 10; engagement holes 3a for engaging the swivel joint SJ are formed by piercing as shown in Figs. 8 and 9; and screw holes 3b for screws used for attachment to the track frame 1 are made by piercing. Accordingly, only the cutting of the square bar material SS and the formation of the engagement holes 3a and the screw holes 3b are necessary for processing. Note that attachment to the track frame 1 (the lower plate 1D) is done only by screwing bolts 19 (see Fig. 9) into the track frame 1 through the screw holes 3b.

[0016]

In contrast with this, the conventional swivel joint mounting member 3' is mounted in such a way that as shown in Figs. 11 to 13, a steel plate material is bent into the shape of Japanese letter ㄷ and mounting seats 3'a having screw holes 3'b used for bolting the swivel joint SJ are secured to a horizontal face part by welding. In addition, female screws 3c' are vertically disposed at a lower part for attachment to the track frame 1' (a lower plate 1'a) and therefore welding of the female screws 3c' is required. Accordingly, the formation of the

conventional swivel joint mounting member 3' comprises the steps of cutting plates of specified sizes down from a sheet material by fusing; bending the cut plates; welding the mounting seats 3'a; making screw holes 3'b in the mounting seats 3'a by piercing; and welding the female screws 3'c.

[0017]

As described above, the swivel joint mounting member 3 of the invention requires a less number of processing steps so that it can be manufactured at lower cost and easily attached to the track frame 1, compared to the conventional swivel joint mounting material 3'. In addition, since the swivel joint mounting member 3 is not formed by bending a sheet material but made of a square bar material, it is heavy in weight, so that the weight of the track frame 1 can be increased by attaching it. This causes an increase in the weight of the crawler running system A which is located in a lower position than the main body part C. As a result, with the form of the main body part A shown in Figs. 1 and 2, the position of the center of gravity can be corrected while keeping good turning ability.

[0018]

In comparison with the structure of the track frame 1' of the conventional compact slewing-type work vehicle, there will be concretely explained a structure of the track frame 1 incorporated in the crawler running system A of the invention, the structure of the track frame 1 being applicable to large-sized work vehicles. As shown in Figs. 4 and 5, the track frame 1 includes an upper plate 1U and a lower plate 1D which are bent so as to have a trapezoidal shape in a front view and disposed in substantially parallel with each other. More specifically, the centers of the upper and lower plates 1U, 1D are in the form of a horizontally flat surface and hydraulic pipe holes 1Ua, 1Da are made on the centers of the upper and lower plates 1U, 1D respectively. Both sides of each plate are inclined, taking the form of Japanese letter 八. Both side edges of the upper plate 1U are welded to the inclined upper faces of the crawler frames 2, whereas both side edges of the lower plate 1D are welded to the inner vertical faces of the crawler frames 2. For weight and cost reduction, notch parts 1Ub, 1Db are formed at the substantially length-wise centers of the inclined faces of the plates 1U, 1D such that the plates 1U, 1D take the form of an arch in plan.

[0019]

Disposed between the front end of the upper plate 1U and the front end of the lower plate 1D are front loader brackets 5 and a cylinder bracket 6 which

project forward. The front loader brackets 5 are positioned at the right and left, for pivotably supporting the right and left ends of the front loader FL. The cylinder bracket 6 is positioned at the center, for pivotably supporting a front loader driving hydraulic cylinder FLC which is an actuator for the front loader FL.
[0020]

In the horizontal surface part at the center of the upper plate 1U, an annular bearing mounting seat 4 for mounting the bearing B is secured by welding. Previously, the bearing mounting seat 4 was ground at its surface after being welded onto the track frame 1' (the upper plate 1'U) as shown in Fig. 3. However, this has the problem that the position of the bearing mounting seat 4 is fixed at the time of surface grinding and therefore surface grinding cannot be carried out without use of a large-scaled machine tool. To cope with this, the invention is designed to weld the bearing mounting seat 4 to the upper face of the upper plate 1U after applying surface treatment to the bearing mounting seat 4 which is a single piece, in order to enable use of the machine tool used for machining the conventional compact slewing-type work vehicle without modification. The bearing mounting seat 4 which is not fixed to the track frame can be surface-treated even with a small-sized machine tool, by moving the position of the bearing mounting seat 4.
[0021]

Disposed inside the bearing mounting seat 4 is a swivel joint protecting tube 7 which stands up near the hydraulic pipe hole 1Ua formed on the upper plate 1U. At an underneath position, the hydraulic pipe hole 1Da is formed on the central horizontal face part of the lower plate 1D as described earlier. The swivel joint mounting member 3 is attached to the lower plate 1D so as to bridge the hydraulic pipe hole 1Da, extending in a length-wise direction. The attachment of the swivel joint mounting member 3 is done by bolting with the bolts 19 as described earlier. The bottom part of a swivel joint SJ is fixedly engaged with the upper face of the swivel joint mounting member 3 thus secured, by inserting knock pins SJa into the engagement holes 3a. Accordingly, the swivel joint protecting tube 7 annularly covers the swivel joint SJ thus arranged.
[0022]

In the track frame 1' for the conventional compact slewing-type work vehicle, upper plates 1'U, 1'D, which are vertically bent into a trapezoidal shape in a front view, are disposed so as to bridge the right and left crawler frames 2' as shown in Figs. 3, 6 and 7, and front loader brackets 5' and cylinder bracket 6' are

attached to the leading end. The central horizontal face parts of the upper plate 1'U and the lower plate 1'D are provided with hydraulic pipe holes 1'Ua, 1'Da respectively and the swivel joint mounting part 3' is attached so as to stride over the hydraulic pipe hole 1'Da of the lower plate 1'D. A swivel joint protecting tube 7' is disposed in the neighborhood of the hydraulic pipe hole 1'a of the upper plate 1'U positioned above it, and the bearing mounting seat 4' is disposed around it. In the inclined part of the upper plate 1'U and the lower plate 1'D, notch parts 1'Ub, 1'Db are formed similarly.

[0023]

The structure of the upper plate 1U of the track frame 1 of the invention will be described with reference to Figs. 4, 5 and 14 to 17. The upper plate 1U is laterally divided into two parts, i.e., a left upper plate 1UL and a right upper plate 1UR. The central side edges of these upper plates 1UL, 1UR are joined together through joint members 20 by welding at the central right and left parts of the track frame 1 so that they become integral. More specifically, the side edge of the left upper plate 1UL is welded to the left crawler frame 2, whereas the side edge of the right upper plate 1UR is to the right crawler frame 2.

[0024]

In contrast with this, the upper plate 1'U (shown in Figs. 6 and 7) used for the track frame 1' for the conventional compact slewing-type work vehicle is formed from a single sheet material and both side edges of it are welded to the crawler frames 2'. However, a torsional stress is concentrated on edge parts which respectively extend from the rear ends of the right and left inclined parts of the upper plate 1'U to the rear ends (the side on which the driving sprockets DS are suspended) of the right and left crawler frames 2'. Therefore, upper plate reinforcing plate materials 21 are provided apart from the upper plate 1'U. At the rear end of the lower plate 1'D, lower plate reinforcing materials 22, which differ from the lower plate 1'D, are disposed similarly in parallel with the upper plate reinforcing plate materials 21. On the upper faces of the upper plate 1'U and the upper plate reinforcing plate materials 21, patch members are fixedly attached in the vicinity of a weld joint part X between the upper plate 1'U and the upper plate reinforcing plate materials 21, for the purpose of reinforcement, i.e., reducing the stress imposed on this part. Specifically, a patch member 23 is fixedly attached to the upper plate 1'U whereas patch members 24 to the right and left upper plate reinforcing plate materials 21.

[0025]

Under normal circumstances, there is no need to weld the patch members 23, 24 to the edges of these members, as far as strength can be ensured by extending the trailing end portion of the upper plate 1'U in an integral fashion without use of the separated upper plate reinforcing plate material 21. However, it is difficult in view of dimension to cut the upper plate 1'U in integral form, which includes the areas where the upper plate reinforcing plate materials 21 are attached, out from a steel plate by fusing. Therefore, there is no way besides cutting the upper plate 1'U, which does not include the upper plate reinforcing plate materials 21, out from a steel plate SP by fusing as shown in Fig. 14. This means that the upper plate reinforcing plate materials 21 need to be attached separately from the upper plate 1'U and therefore, the patch members 23, 24 become necessary. For the same reason, the lower plate reinforcing plate materials 22 have to be attached as a separated member in the case of the lower plate 1'D.

[0026]

Where an upper plate 1"U, which has the same shape as the upper plate 1'U but is larger than the upper plate 1'U and excludes the right and left edge parts, is cut out from the steel material SP by fusing to be applied to the large-sized slewing-type work vehicle shown in Figs. 1 and 2, the size of the upper plate 1"U is not just the right size for the vertical and lateral dimensions of the whole steel plate SP. Concretely, if the upper plate 1"U is taken from the steel plate SP in such a way that the longer side of the upper plate 1"U corresponds to the shorter side a of the steel pate SP as shown in Fig. 15, the upper plate 1"U will be too short. On the other hand, if the longer side of the upper plate 1"U corresponds to the longer side b of the steel plate SP as shown in Fig. 16, one piece of upper plate 1"U can be cut out but the remaining part of the steel plate SP after cutting the upper plate 1"U is not long enough to cut out another piece of upper plate 1"U.

[0027]

To solve this problem, the following measure is taken. An integral upper plate 1U, which includes the edge parts where the upper plate reinforcing plate materials 21 are originally disposed, is divided at a widthwise center line into a left upper plate 1UL and a right upper plate 1UR which are bilaterally symmetric. These left and right upper plates 1UL, 1UR are cut out by fusing from one piece of steel plate SP as shown in Fig. 17, so that the perfect left and right upper plates 1UL, 1UR can be obtained without leaving waste.

[0028]

As to the lower plate 1D, the integral lower plate 1D including the edge parts where the lower plate reinforcing plate materials 22 are originally disposed is used. Compared to the upper plate 1U, the lateral size of the lower plate 1D is shorter so that a piece of lower plate 1D can be cut out from the steep plate SP, leaving a portion large enough to cut out another piece of lower plate 1D therefrom. Therefore, the steel plate SP can be used up without futility. Thus, the lower plate 1D does not need to be divided into two parts, but can be cut out as a single piece unlike the upper plate 1U.

[0029]

Reference is now made to Figs. 4 and 5 to describe the ribbed plates arranged in a vertical direction between the upper plate 1U and lower plate 1D of the track frame 1 of the invention. At the front end, a linear front ribbed plate 1F is disposed so as to extend in a lateral direction in plan. At the rear end, a rear ribbed plate 1R, which is bent into a trapezoidal shape in plan, is disposed so as to bridge the left and right crawler frames 2L, 2R. Disposed between the front ribbed plate 1F and the rear ribbed plate 1R are right and left linear central ribbed plates 1C which extend in parallel in a length-wise direction in plan. These ribbed plates 1C are located in the vicinity of the right and left sides of the hydraulic pipe holes 1Ua, 1Da respectively. A front middle ribbed plate 1MF and a rear middle ribbed plate 1MR are disposed in the vicinity of the front and rear of the notch parts 1Ub, 1Db, extending from the left and right central ribbed plates 1C to the left and right crawler frames 2L, 2R, respectively. The front middle ribbed plate 1MF and the rear middle ribbed plate 1MR, which are positioned at the front part and the rear part respectively with the same notch parts 1Ub, 1Db therebetween, are arranged in the form of Japanese letter 八, gradually separating from each other from the center toward the side in plan.

[0030]

Reference is made to Figs. 6, 7 to describe the rib structure of the conventional track frame 1'. In the conventional track frame 1', a front ribbed plate 1'F, a central ribbed plate 1'C and front/rear middle ribbed plates 1'MF, 1'MR are arranged in the same fashion. The rear ribbed plate 1'R is parallel to the rear ends of the upper plate 1'U and the lower plate 1'D, linearly extending in a lateral direction in plan. Disposed between the upper plate reinforcing plate materials 21 and the lower plate reinforcing plate materials 22 is a rear reinforcing ribbed plate 25 which extends from the rear ribbed plate 1'R to the

crawler frame 2.

[0031]

In the conventional track frame 1', the joint part between the upper plate 1'U and the upper plate reinforcing plate materials 21 and the joint part between the lower plate 1'D and the lower plate reinforcing plate materials 22 (these upper and lower weld joint parts are designated by X) are shortened in lateral length, in order to minimize, in view of strength and cost, the weld part between the upper plate 1'U and the upper plate reinforcing plate materials 21 and the weld part between the lower plate 1'D and the lower plate reinforcing plate materials 22. Therefore, the joint part P1' between the rear reinforcing ribbed plate 25 and the rear ribbed plate 1'R is significantly shifted to the right side or left side from the widthwise center.

[0032]

Properly speaking, it is desirable to increase the distance L' between the weld leading end part P2a' at a side edge of the rear reinforcing ribbed plate 25 and the weld leading end part P3a' at a side edge of the rear middle ribbed plate 1'MR for the reason that a torsional stress is imposed on the edge part between the upper plate 1'U / lower plate 1'D and the rear part of the crawler frame 2'. However, the weld part P2a' at the side edge of the rear reinforcing ribbed plate 25 cannot be shifted backward that much and therefore the distance L' cannot be sufficiently increased, because the weld joint part X between the upper plate 1'U and the upper plate reinforcing plate materials 21 and the weld joint part X between the lower plate 1' D and the lower plate reinforcing plate materials 22 are shortened as described earlier. In view of this, it is necessary to employ other means for increasing torsional rigidity. For instance, both side edges of the rear ribbed plate 1'R are extended to the crawler frame 2' (i.e., an extension part 1'Ra is provided) and welded (weld part P6), or alternatively, the patch members 23, 24 are fixedly attached as described earlier.

[0033]

In contrast with this, the function of the ribbed plate structure including the rear ribbed plate 1'R and whole right/left rear reinforcing ribbed plates 25 of the conventional track frame 1' is possessed by only the rear ribbed plate 1R of the track frame 1 of the invention. More specifically, since the upper plate 1U and the lower plate 1D are respectively integrally formed such that the edge part extends in an integral fashion from the rear end of the track frame 1 to the rear portion of the crawler frame 2 as described earlier, the weld joint parts X such as

seen in the prior art do not exist. The rear ribbed plate 1R is in bent form in plan, having a laterally linear part 1Ra and an inclined part 1Rb which is positioned at a side edge and inclines backward. The joint between the parts 1Ra and 1Rb is a bent position P1 which corresponds to the above-described joint position P1' and can be shifted closer to the widthwise center than the conventional joint position P1'. By just that much, the weld leading end part P2a at the side edge of the rear ribbed plate 1R on each of the crawler frames 2L, 2R can be shifted backward, so that the length-wise distance L between the weld leading end part P2a and the weld leading part P3a at the side edge of the rear middle ribbed plate 1MR can be increased, thereby increasing torsional rigidity. In addition, since the weld joint parts X such as seen in the prior art do not exist, the extension part 1'Ra which extends from the joint position P1' of the rear ribbed plate 1'R to the weld part P4 can be omitted while keeping satisfactory torsional rigidity, and as a result, the cost of that part can be saved. [0034]

The track frame 1 has been described above. Next, the crawler frame 2 for a large-sized slewing-type work vehicle will be explained with reference to Figs. 18, 20 to 22. The crawler frame 2 is formed by bending a substantially single-piece steel plate such that it is in the form of a pentagon from which the lower side is eliminated as shown in Fig. 22. As explained earlier, the driving sprocket supporting member 9 for retaining the driving sprocket DS is engaged with the rear end by welding, whereas the idler supporting member 8 for retaining the idler IR is engaged with the front end by welding. Disposed within the crawler frame 2 is a middle ribbed plate located in place. Placed in the vicinity of the front end is a front middle ribbed plate 2a which is bent substantially in the form of L in a side view. A central middle ribbed plate 2b is placed substantially behind it. In the vicinity of the rear end, a rear middle ribbed plate 2c in the form of a vertical face is disposed. The vertical face portion of the front middle ribbed plate 2a and the vertical face portion of the front middle ribbed plate 2b are extensions of vertical weld parts P5, P4, respectively, of the side edges of the front ribbed plate 1F and the front middle ribbed plate 1MF which are welded to the outer face of the inner vertical face of the crawler frame 2. The rear middle ribbed plate 2c is also an extension of the vertical weld part P2 of the rear ribbed plate 1R welded to the outer face of the inner vertical face of the crawler frame 2. By providing the vertical face portions of the middle ribbed plate 2a, 2b, 2c which are extensions of the weld parts P5,

P4, P2 of the ribbed plates 1F, 1MF, 1r of the track frame 1 welded to the inner surface of the crawler frame 2, the weld parts are not displaced so that shearing force is unlikely to be generated and the strength of the crawler frame 2 can be ensured.

[0035]

A conventional crawler frame 2' is formed by similarly bending a steel plate as shown in Fig. 19. A driving sprocket supporting member 9' is engaged with the rear end by welding and an idler supporting member 8' is engaged with the front end by welding. An L-shaped front middle ribbed plate 2'a, a central middle ribbed plate 2'b and a vertical-face-shaped rear middle ribbed plate 2'c are disposed inside. The vertical face portion of the front middle ribbed plate 2'a and the rear middle ribbed plate 2'c are extensions of weld parts P5', P2', respectively, of the front ribbed plate 1'F, front middle ribbed plate 1'MF and rear ribbed plate 1'R of the track frame 1' which are welded to the outer face of the inner vertical face of the crawler frame 2'.

[0036]

In this way, the vertical face portions of the middle ribbed plates of the crawler frame are heretofore designed to be extended from the weld parts of the ribbed plates of the track frame which are welded to the crawler frame, so that shearing force generation is prevented. Of the middle ribbed plates of the conventional crawler frame 2', the horizontal face part of the front middle ribbed plate 2'a is especially long in a length-wise direction. Moreover, no consideration is given to the positional relationship between a horizontal weld part Q1' relative to the inner face of the vertical face of the crawler frame 2 and a horizontal weld part Q2' of a side edge of the lower plate 1'D of the track frame 1' which is welded to the outer face of the inner vertical face of the crawler frame 2', so that vertical displacement occurs as shown in Fig. 19. The displacement of the weld parts Q1' and Q2' also causes occurrence of shearing force and therefore is undesirable in view of the strength of the crawler frame 2'.

[0037]

In the crawler frame 2 of the present embodiment shown in Fig. 18, the horizontal weld part Q1 of the front middle ribbed plate 2a welded to the inner face of the vertical face of the crawler frame 2 and the horizontal weld part Q2 of the lower plate 1D of the track frame 1 welded to the outer face of the inner vertical face of the crawler frame 2 are so positioned as to substantially overlap each other in a side view, whereby shearing force is prevented from occurring

and the strength of the crawler frame 2 is increased.

[0038]

Next, the coupling structure of the idler supporting member 8 located at the front end of the crawler frame 2 will be explained. The front end of the crawler frame 2' will be notched so as to be fit to the shape of the idler supporting member 8', and the substantially entire face of the front end of the crawler frame 2' is coupled so as to be covered with an idler retaining member 5'. Incidentally, if the crawler frame 2 for use in the large-sized slewing-type work vehicle is bent with a conventional process using a machine tool capable of bending the crawler frame 2' of the compact slewing-type work vehicle from its front end to its rear end, the front-to-back length of the crawler frame 2 is too long. Therefore, the front-to-back length of the crawler frame 2 itself is limited in order that the crawler frame 2 can be processed by the conventional bending machine tool. Additionally, the crawler frame 2 of the present embodiment shown in Fig. 18 has a structure in which the front end of the crawler frame 2 is engaged by fusing with the idler retaining member 5 at the periphery of the rear end thereof in order that the entire length from the front end of the idler supporting member 8 to the rear end of the driving sprocket supporting member 9 is ensured. More specifically, by extending only the idler retaining member 5 forward without elongation of the front end portion of the crawler frame 2, the entire length applicable to the large-sized slewing-type work vehicle is obtained. In addition, the front-to-back length of the crawler frame 2 can be restricted, which contributes to cost savings.

[0039]

Lastly, the suspension structure of the upper roller UR of the crawler frame 2 will be described. In the conventional crawler frame 2', un upper roller supporting frame 10' such as shown in Figs. 23 to 25 is projectingly placed at an upper position as a suspension device for the upper roller UR. The upper roller supporting frame 10' is configured such that, as shown in Fig. 25, the proximal end as viewed in a front view is thickened by provision of a bent part 10'a, thereby ensuring its rigidity. Further, the weld area R' is sufficiently kept for the outer face of the crawler frame 2'. Since such an upper roller supporting frame 10' is formed by cutting a steel plate by fusing, elaborate processing and a large number of processing steps are required. On the other hand, the upper roller supporting frame 10 for the crawler frame 2 of the present embodiment shown in Figs. 20 to 22 is formed by only cutting a square steel bar material and its bottom

face is attached to the upper face of the crawler frame 2 by fusing so as to stand thereat. Therefore, the weld area of the proximal end is not so large. In this case, the rigidity of the proximal end is increased by fixedly attaching a protective plate 26 for preventing falling to the internal side of the crawler frame 2 by welding such that the protective member 26 is inclined when viewed in a front view. In contrast with the conventional suspension structure for the upper roller 8, the suspension of the present embodiment has the advantage that although the number of parts is increased by addition of the protective plate 26, the upper roller supporting frame 10 and the protective plate 26 can be manufactured through easy processing, resulting in a reduction in the number of processing steps.

[0040]

[Effects of the Invention]

The above-described track frame processing of the invention, which takes account of the case where the structure of a compact slewing-type work vehicle is applied to a large-sized slewing-type work vehicle without modification, has the following effect. As described in Claim 1, the mounting member for a swivel joint attached to the track frame is formed from a square bar material and therefore the weight of the swivel joint mounting member is increased compared to the conventional structure formed by bending a sheet material, so that the weight of the lower part of the main body part of the slewing-type work vehicle increases. With the increased weight of the lower part of the main body part, the rear end of the main body part does not bulge out like the structure of the compact slewing-type work vehicle and therefore does not project outwardly from the crawler running system even when the system is in turning operation, so that good turning ability can be ensured, while preventing forward displacement of the center of gravity and, in consequence, ensuring stability. In addition, the number of processing steps as well as cost can be reduced, compared to processing of the conventional swivel joint mounting member.

[0041]

When machining the bearing mounting seat which has already been welded to the track frame, it is difficult for a processing machine such as a cutter which can be used for the track frame of a compact slewing-type work vehicle to machine the entire surface of the bearing mounting seat by changing the position of the machine for every track frame. Therefore, there have been strong demands for larger-sized processing machines. However, a

single-piece bearing mounting seat can be moved even if it is large in size, by such a technique as described in claim 2 according to which a bearing mounting seat which has been machined beforehand is securely welded to the track frame, so that the conventional processing machine used for constructing a compact slewing-type work vehicle can be used. This leads to cost reduction.

[0042]

In addition, the upper plate part of the track frame is formed by cutting sheet material by fusing. In the conventional compact slewing-type work vehicle, an integral upper plate is formed between the right and left crawler frames and an reinforcing sheet material is provided for each of edge parts which respectively extend from the rear end of the above integral upper plate to the rear part of each crawler frame. That is, three pieces of sheet material are necessary for the conventional track frame. The upper plate of the track frame of a large-sized slewing-type work vehicle to which the above conventional upper plate structure is applied is long in lateral length. Therefore, if the upper plate is cut out from a sheet material with the conventional process, the upper plate having enough length cannot be obtained. If the direction of cutting out the upper plate from the sheet material is changed, one perfect upper plate may be obtained but the area of the remaining part of the sheet material is not large enough to take another upper plate therefrom. In addition, the torsional stress imposed on the weld part between each reinforcing sheet material and the upper plate increases, causing a need for an additional reinforcement structure.

[0043]

In this respect, the upper plate is divided into two (right and left parts) at a widthwise center as described in claim 3, whereby many halves (right and left parts) can be taken from a sheet material, without leaving waste material. This contributes to cost savings. In addition, the edge parts each extending from the rear end of the upper plate to the rear part of each crawler frame can be integrally formed with the two-split upper plate, so that the weld parts located between the upper plate and the reinforcing plate materials such as seen in the conventional structure can be eliminated. This eliminates the need to provide a reinforcement structure such as in the conventional structure so that the torsional rigidity of the edge parts can be ensured, which also leads to cost reduction.

[0044]

In cooperation with the structure described in claim 3, the rear ribbed

structure of the track frame, in which the edge parts, each extending from the rear end of the upper plate to the rear part of each crawler frame, are integrally formed with the upper plate, reinforces the joint part between the upper plate and the reinforcing plate material of each edge part. Therefore, there is no need to use three ribbed plates in order to reinforce the joint structure between the upper plate and the reinforcing plate material of each edge part, but the same reinforcing effect can be obtained by bending only the rear ribbed plate into the form of Japanese letter 八 in plan. This leads to cost reduction. Since no joint exists between the rear end of the upper plate and the reinforcing plate materials of the edge parts unlike the conventional structure, the bent part of the rear ribbed plate can be shifted close to the widthwise center, thereby shifting the weld part of the side edge of the rear ribbed plate mounted on the crawler frames backward. As a result, the front-to-back distance between the weld part of a side edge of the rear middle plate relative to each crawler frame and the weld part of the side edge of the rear ribbed plate can be made long, thereby achieving further increased torsional rigidity. The invention is applicable to slewing-type work vehicles such as slewing cranes, slewing excavators and slewing crushing machines.

[Brief Description of the Drawings]

[Fig. 1] An entire side view of a slewing-type work vehicle having a swivel joint mounting part 3 according to the invention

[Fig. 2] A plan view of a slewing-type work vehicle

[Fig. 3] An exploded perspective view showing a mounting structure of a main body frame attached to a frame of a conventional crawler running system

[Fig. 4] A plan view of a frame of a crawler running system for use in a large-sized slewing-type work vehicle

[Fig. 5] A side view of the same

[Fig. 6] A plan view of a frame of a crawler running system for use in a conventional compact slewing-type work vehicle

[Fig. 7] A side view of the same

[Fig. 8] A plan view showing a mounting structure of the swivel joint mounting member 3 at a lower plate 1D of a track frame 1 according to the invention

[Fig. 9] A cross sectional view of the same

[Fig. 10] A perspective view showing a way of constructing the swivel joint mounting member 3 by cutting a square bar material SS

[Fig. 11] A plan view showing a mounting structure of a conventional swivel

joint mounting member 3' at a lower plate 1'D of a conventional track frame 1'

[Fig. 12] A cross sectional view of the same

[Fig. 13] A perspective view of the conventional swivel joint mounting member 3'

[Fig. 14] A schematic plan view showing cutting-out of an upper plate 1'U from a steel plate SP, the upper plate 1'U being for a track frame 1' for the conventional compact slewing-type work vehicle

[Fig. 15] A schematic plan view showing cutting-out of an upper plate 1"U for a large-sized slewing-type work vehicle from the steel plate SP in a direction of a short side a in a conventional manner

[Fig. 16] A schematic plan view showing cutting-out of the same in a direction of a long side b

[Fig. 17] A schematic plan view showing cutting-out of an upper plate 1U for the large-sized slewing-type work vehicle of the invention from the steel plate SP, the upper plate 1U being laterally divided into two parts

[Fig. 18] Views of a crawler frame 2 for the large-sized slewing-type work vehicle, wherein (a) is a plan view and (b) is a side view

[Fig. 19] Views of a crawler frame 2' for the conventional compact slewing-type work vehicle, wherein (a) is a plan view and (b) is a side view

[Fig. 20] A plan view showing a suspension structure of an upper roller UR of the crawler frame 2

[Fig. 21] A side view of the same

[Fig. 22] A rear view of the same

[Fig. 23] A plan view showing a suspension structure of an upper roller UR of a conventional crawler frame 2'

[Fig. 24] A side view of the same

[Fig. 25] A side view of the same

[Explanation of Reference Numerals]

A: crawler running system

B: bearing

C: main body part

SJ: swivel joint

1: track frame

1U: upper plate

1UL: left upper plate

1UR: right upper plate
1D: lower plate
1F: front ribbed plate
1MF: front middle ribbed plate
1MR: rear middle ribbed plate
1R: rear ribbed plate
1a: hydraulic pipe hole
1b: notch part
2: crawler frame
3: swivel joint mounting member
3a: engagement hole
3b: screw hole
4: bearing mounting seat